Space Weather Technical Forecast

Issued on Thursday, 04 November 2021 at 12:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G3/Strong or G4/Severe geomagnetic storms expected early on day 1 (4th), with G1/Minor to G3/Strong geomagnetic storms likely early day 2 (5th). Slight chance of further M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: There are two sunspot regions on the visible disc with observed solar activity returning to Low over the past 24 hours. The peak flare was a long-duration event C5.2 from AR2891 at 03/2117 UTC. AR2891 (Cai/Beta-Delta) has a delta spot in its trailing penumbra, however there has been some slight reduction in overall size, and decay in its lead/trailer spots. AR2893 (Hsx/Alpha) in the northeast quadrant appears stable with very little recent activity. A CME was observed leaving the sun associated with the C5 flare. This is awaiting analysis, but appears not to be earth-directed.

The CME which was observed leaving the Sun early on the 2nd November arrived at L1 DSCOVR around 03/1930 UTC and Earth around 03/2000 UTC.

Solar Wind / Geomagnetic Activity: Initial solar wind parameters were indicating a waning connection to the high speed stream from coronal hole 16 (around 500-550km/s). However, following the arrival of the CME they increased to near 750 km/s. A steady but slight decline to speeds of 670km/s was observed to the end of the period. Density had been stable and near average, but increased to a maximum of 28 ppcc (above average) following the CME, before easing back to around 10 ppcc. Total IMF, Bt, was weak, in the range 2-5 nT, then increased in response to the CME to a maximum of 24 nT at 03/2038 UTC before easing back to around 15-20 nT, though a further increase to around 24nT occurred after 04/0630UTC The north-south component, Bz fluctuated weakly before a strong negative dive post-CME to a value of -16 nT following the arrival of the CME. A prolonged period of negative Bz was observed from 04/0400UTC onwards, with a peak value of -18 nT at 04/0820 UTC. Phi angle was mostly positive (away from the sun) with only brief negative (towards the sun) fluctuations. Geomagnetic activity was Quiet to Unsettled until the 1800-2100 UTC interval when it became Active (Kp4). At the 2100-2359 UTC interval a G3/Strong geomagnetic storm was observed. G2/Moderate to G3/Strong activity was recored 04/0000-0900 UTC, followed by a G4/Severe storm interval 0900-1200 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured by GOES-16 remained slightly elevated but below the S1 level, before briefly exceeding S1/Minor storm level between 03/2055 UTC and 03/2105 UTC. The high energy electron flux (greater than 2 MeV) was mainly at background levels with only a brief increase into Moderate levels around 04/1100 UTC. The associated 24-hour electron fluence was below the Active (1e8 integrated pfu) threshold, and with 4.96e6 integrated pfu recorded at 04/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to remain mainly low through the next four days, but

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with a continuing slight chance of M-class flares.

Solar Wind / Geomagnetic Activity: Solar wind speeds are currently at strong levels (around 670km/s) owing to the arrival of the CME that arrived at earth late in the UTC day on the 3rd. As the effects from this feature wane in the coming days a reduction in speeds is anticipated to slightly elevated or background levels. Geomagnetic activity is currently at G4/Severe Storm levels. Activity is expected to reduce on day 1 (4th) and day 2 (5th) back to Active/Kp4 to G2/Moderate storm levels with a chance of an isolated G3/Strong storm interval. By days 3 and 4 (6th and 7th) activity is expected to be Quiet to Unsettled with a slight chance of Active intervals.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain below the S1 minor storm level with just a slight chance of exceedance on days 1 and 2 (4th and 5th). The high energy electron flux (greater than 2 MeV) is forecast to be at mainly background to moderate levels, with an increasing chance of reaching sustained moderate or occasionally high levels through the period especially towards days 3 and 4 (6th and 7th). Corresponding 24 hour electron fluence values are expected to remain below the Active (1e8 integrated pfu) level during days 1 and 2 (4th and 5th), although a rising trend is likely after the effects of the CME wane through days days 3 and 4 (6th and 7th).

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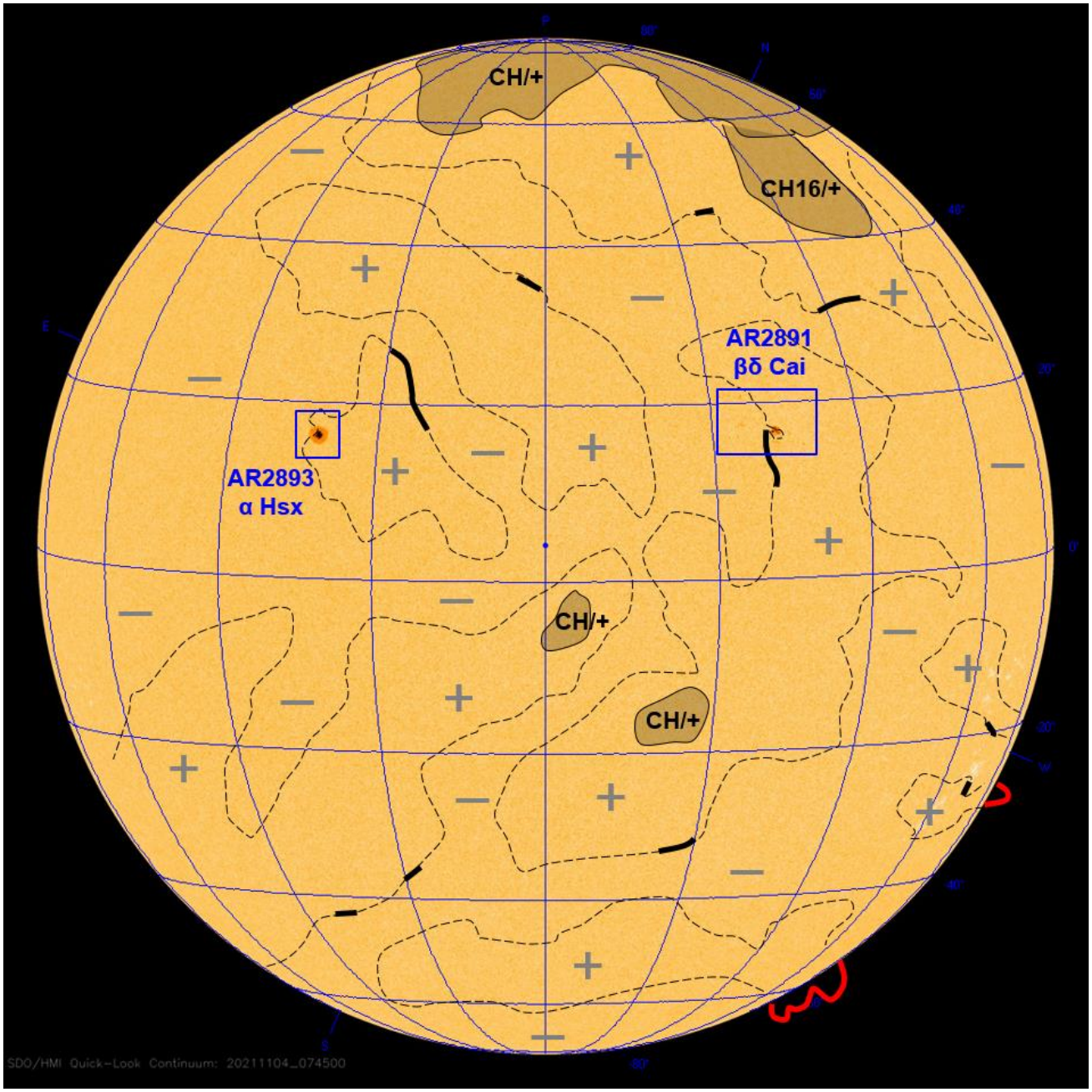
Figure 1. Solar Analysis Valid 04/0745 UTC .



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:
Solar wind speeds are currently at strong levels (around 670km/s) owing to the arrival of the CME that arrived at earth late in the UTC day on the 3rd. As the effects from this feature wane in the coming days a reduction in speeds is anticipated to slightly elevated or background levels.

A CME was observed leaving the sun to the west, associated with a long-duration C5 flare on the 3rd. This is awaiting analysis, but appears not to be earth-directed.
No other significant coronal hole influences or CMEs are expected, leading a decreasing risk of geomagnetic storms after day 2.
Geomagnetic activity is currently at G4/Severe Storm levels. Activity is expected to reduce on day 1 (4th) and day 2 (5th) back to Active/Kp4 to G2/Moderate storm levels with a chance of an isolated G3/Strong storm interval. By days 3 and 4 (6th and 7th) activity is expected to be Quiet to Unsettled with a slight chance of Active intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	100	90	10	1
Strong	G3	Yes	100	30	1	1
Severe	G4	Yes	90	5	1	1
Extreme	G5	No	5	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections - Nil

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Radio Blackouts - X-Ray Flares:

Solar activity is expected to be mainly low, with an ongoing chance of C-class flare activity and a slight chance of M-class flares. The main risk region is AR2891 (Cai/Beta-Delta), which gave a long duration C5 flare peaking around 04/2117 UTC. AR2887 (Hsx/Alpha) has rotated off the visible disk around the southwest limb.

AR2893 (Hsx/Alpha) in the northeast quadrant appears to be relatively benign with no real signs of recent significant development.

New potential active regions are evident at the southeast quadrant and northeast limb of STEREO-A imagery, and will be monitored they rotate onto the earth-facing disc in the coming days.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	20	20	20
Very Active	R3 to R5 X Class	No	2	2	2	2

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is now below S1/Minor storm levels. However, further minor enhancements from significant flaring remain possible.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	10	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):

High energy electrons (greater than 2MeV) are currently at background to moderate levels. The CME arrival is likely to have led to an uncertain amount of disruption of the radiation belts and adds greater uncertainty to the forecast. A rising trend from current values is anticipated following the CME effects on days 2-4 (5th to 7th), but with low confidence.

Electron fluence values are forecast to remain below the Active (1e8 integrated fluence) threshold on day 1 with a chance of rising above between days 2 and 4 (5th to 7th).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	10	40	40	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	10	10	10

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